



**G70**

# **LOW IMPACT DEVELOPMENT DESIGN PROCESS**

**City and County of Honolulu  
Water Quality Rules Workshop  
June 28, 2017**



# Low Impact Development – Design Process

- Low Impact Development (LID) – Definition
- Stormwater Management Design Approach
- Site Design Strategies
- Source Control BMPs
- Treatment Control BMPs
- Alternative Compliance BMPs
- Discover and Data Collection
- Conceptual Design/Master Planning
- Schematic Design Process



# Low Impact Development (LID) – Definition

## UFC Definition of Low Impact Development:

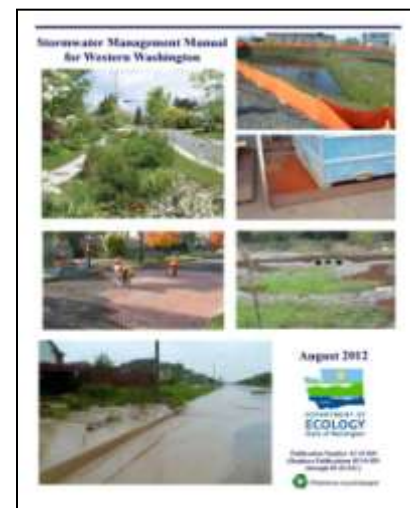
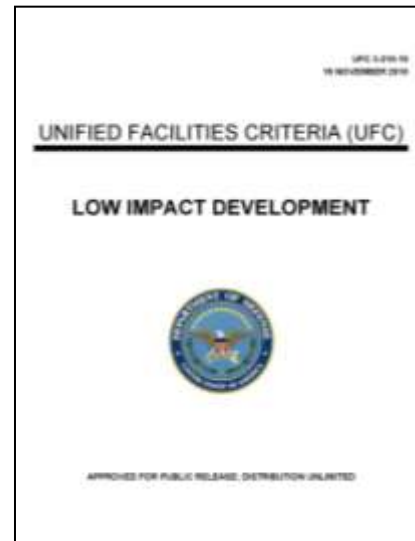
LID is a stormwater management strategy designed to **mimic predevelopment hydrology** including; temperature, rate, volume and duration of flow

## WA DOE and Puget Sound Definition of Low Impact Development:

Low Impact Development (LID) is **a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes by emphasizing integrated management techniques.**

## HUD Definition of Low Impact Development:

Low Impact Development (LID) is an **approach to land development to conserve and protect natural resource systems.**



# Stormwater Management Design Approach

## Collect, Convey and Limit Peak Stormwater Flows

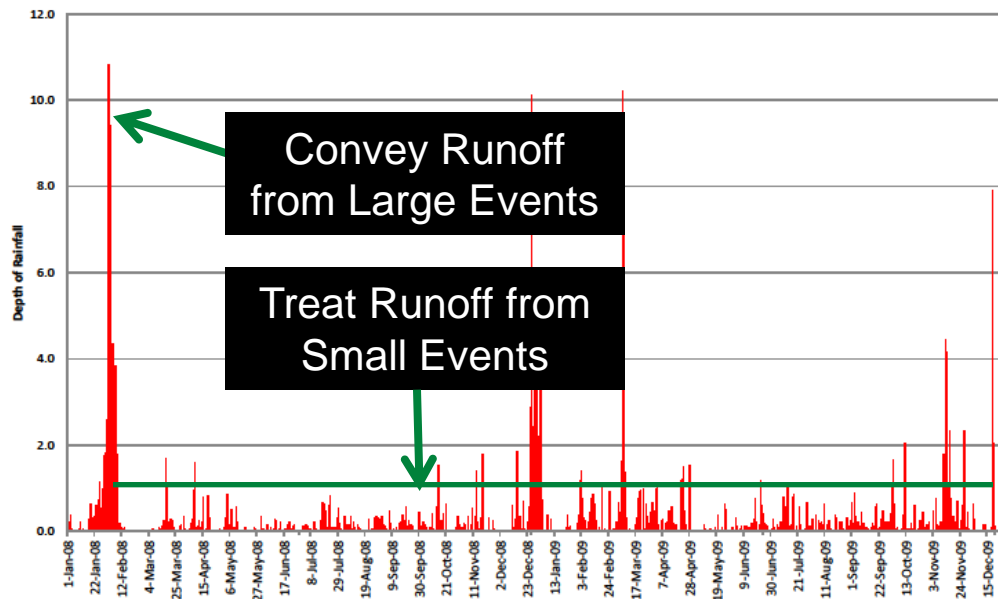
- Maximize flow conveyance and **attenuate peak flows through detention.**
- Limit to **Pre-Development Peak Flow.**
- Minimize flooding and property damage
- Control infrequent large storm flood events

## Collect and Treat Stormwater

- Water quality treatment – **“first flush”** storm events
- Maximize volume of runoff treated by including all small storm events



HILO INTL AP 87  
24 Hour Rainfall, 2008-2009

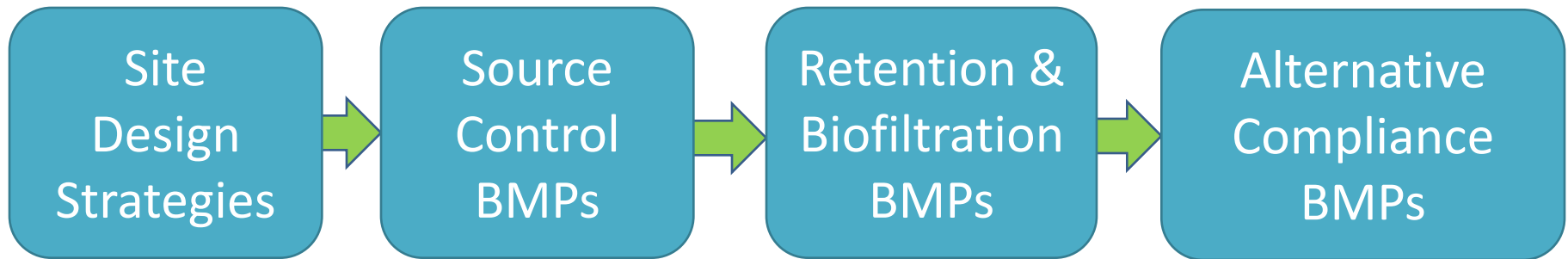




# Stormwater Management Design Approach

## LID Hydrologic Strategy - Disconnect, Distribute, Decentralize

Manage runoff at source to mimic predevelopment hydrology and reduce impacts to the ecosystem



Source control – ***“An ounce of prevention is worth a pound of cure.” Benjamin Franklin***

# Site Design Strategies

- **Conserve natural areas, soils and vegetation**
- **Minimize disturbances to natural drainages**
- **Minimize soil compaction.**
- **Direct runoff to landscaped areas and reduce directly connected impervious areas.**
- **Minimize impervious surfaces.**



# Source Control BMPs

- **Landscaped Areas**
- **Automatic Irrigation Systems**
- **Storm Drain Inlets**
- **Vehicle/Equipment Fueling**
- **Vehicle/Equipment Repair**
- **Vehicle/Equipment Washing/Cleaning**
- **Loading Docks**
- **Outdoor Trash Storage**
- **Outdoor Material Storage**
- **Outdoor Work Areas**
- **Outdoor Process Equipment Operations**
- **Parking Areas**

# Source Control BMPs

Appendix A: Source Control BMP Fact Sheets

- Landscaped Areas
- Automatic Irrigation Systems
- Storm Drain Inlets
- Vehicle/Equipment Fueling
- Vehicle/Equipment Repair
- Vehicle/Equipment Washing/Cleaning
- **Loading Docks**
- Outdoor Trash Storage
- Outdoor Material Storage
- Outdoor Work Areas
- Outdoor Process Equipment Operations
- Parking Areas

## SC-09: Loading Dock



Design Objectives
Maximum Infiltration
Provide On-Site Retention
Slow Runoff
Minimize Impervious Land Coverage
Implement LID
✓ Prohibit Dumping of Improper Materials
✓ Contain Pollutants
Collect and Convey

### Description

Several measures can be taken to prevent operations at loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the storm water conveyance system.

### Approach

In designs for loading docks, containment is encouraged. Preventive measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.



# Source Control BMPs

Appendix A: Source Control BMP Fact Sheets

- Landscaped Areas
- Automatic Irrigation Systems
- Storm Drain Inlets
- Vehicle/Equipment Fueling
- Vehicle/Equipment Repair
- Vehicle/Equipment Washing/Cleaning
- Loading Docks
- **Outdoor Trash Storage**
- Outdoor Material Storage
- Outdoor Work Areas
- Outdoor Process Equipment Operations
- Parking Areas

## SC-10: Outdoor Trash Storage



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
	Collect and Convey

### Description

Storm water runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or streams.

### Approach

Preventive measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

# Treatment Control BMPs

- Infiltration Basin
- Infiltration Trench
- Subsurface Infiltration
- Dry Well
- Bioretention Basin (Rain Garden)
- Permeable Pavement
- Harvesting / Reuse
- Green Roof
- Vegetated Bio-Filter (Bioretention Filter)
- Enhanced Swale (Dry Swale)
- Downspout Disconnection
- Vegetated Swale
- Vegetated Buffer Strip
- Detention Basin
- Manufactured Treatment Device
- Sand Filter

# Treatment Control BMPs

- Infiltration Basin
- Infiltration Trench
- Subsurface Infiltration
- Dry Well
- Bioretention Basin (Rain Garden)
- Permeable Pavement
- Harvesting / Reuse



**LID Retention BMPs**

- Green Roof
- Vegetated Bio-Filter (Bioretention Filter)
- Enhanced Swale (Dry Swale)
- Downspout Disconnection
- Vegetated Swale
- Vegetated Buffer Strip
- Detention Basin
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**LID Retention BMPs**

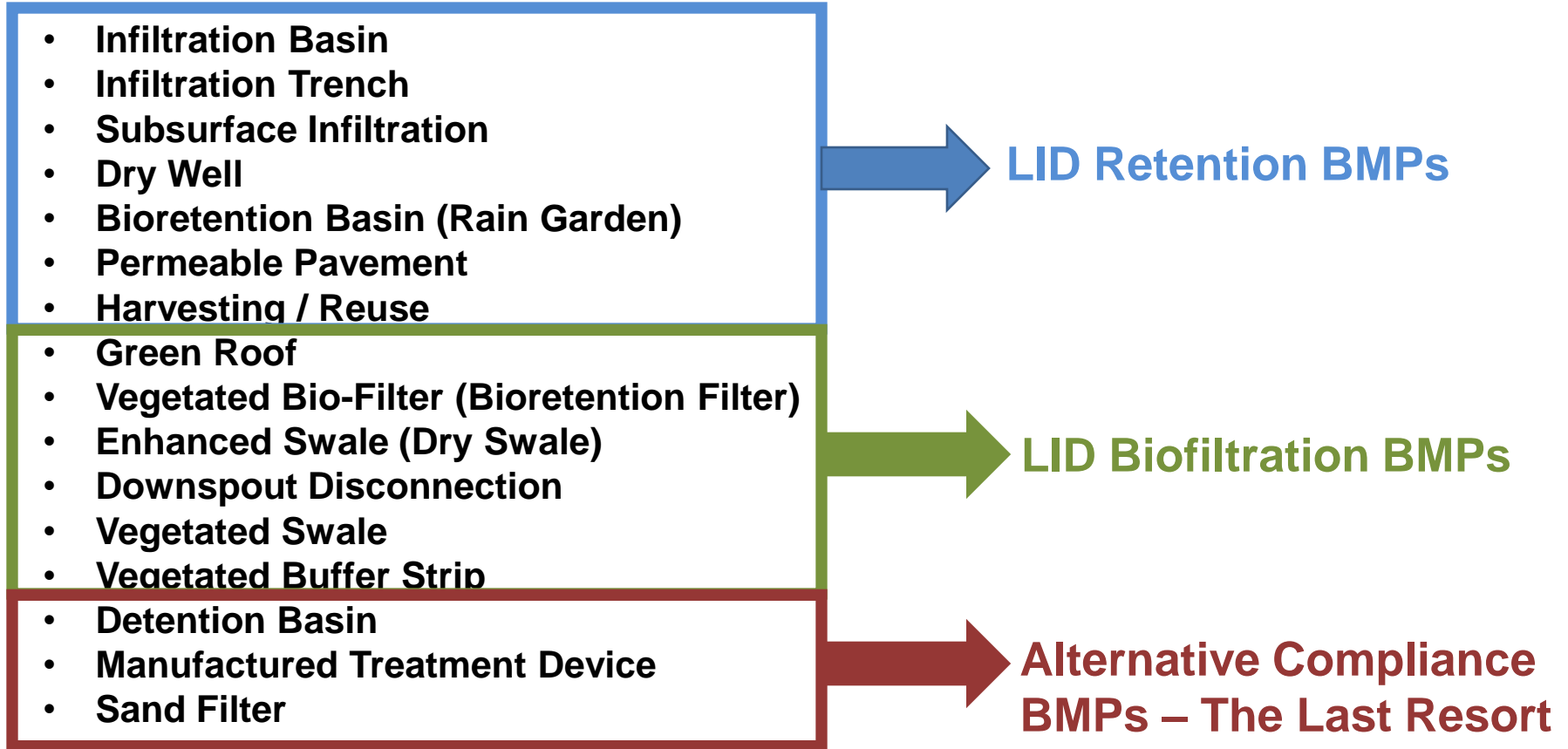
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- Downspout Disconnection
- Vegetated Swale
- Vegetated Buffer Strip



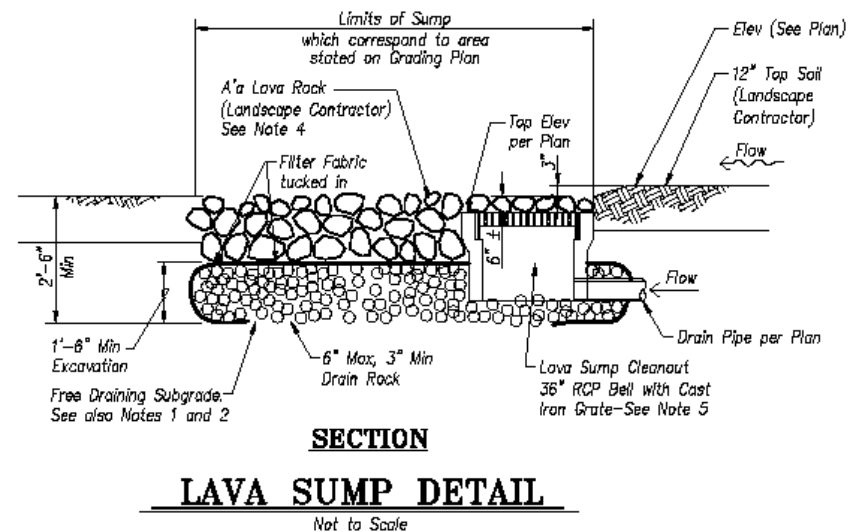
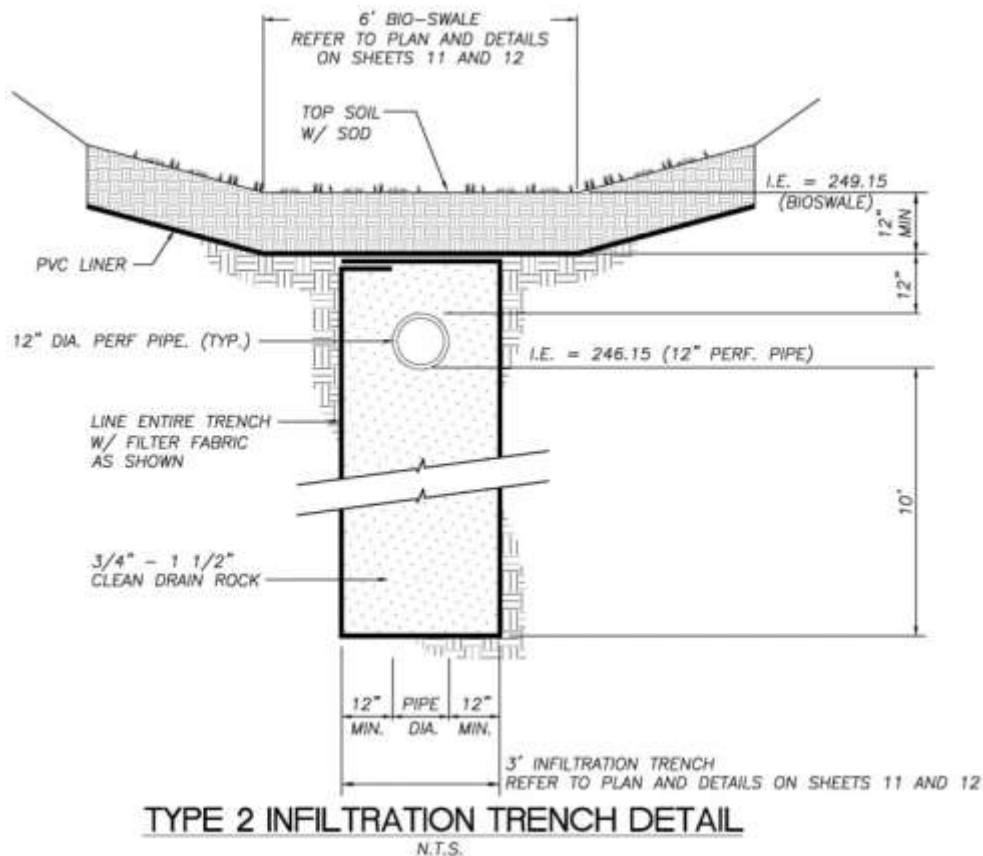
**LID Biofiltration BMPs**

- Detention Basin
- Manufactured Treatment Device
- Sand Filter

# Treatment Control BMPs

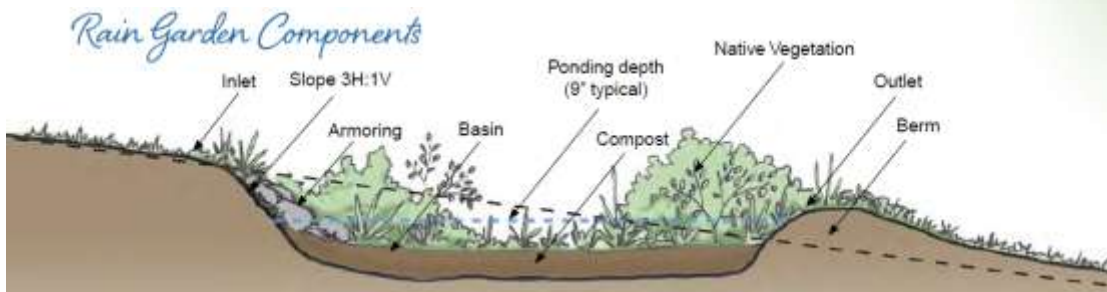
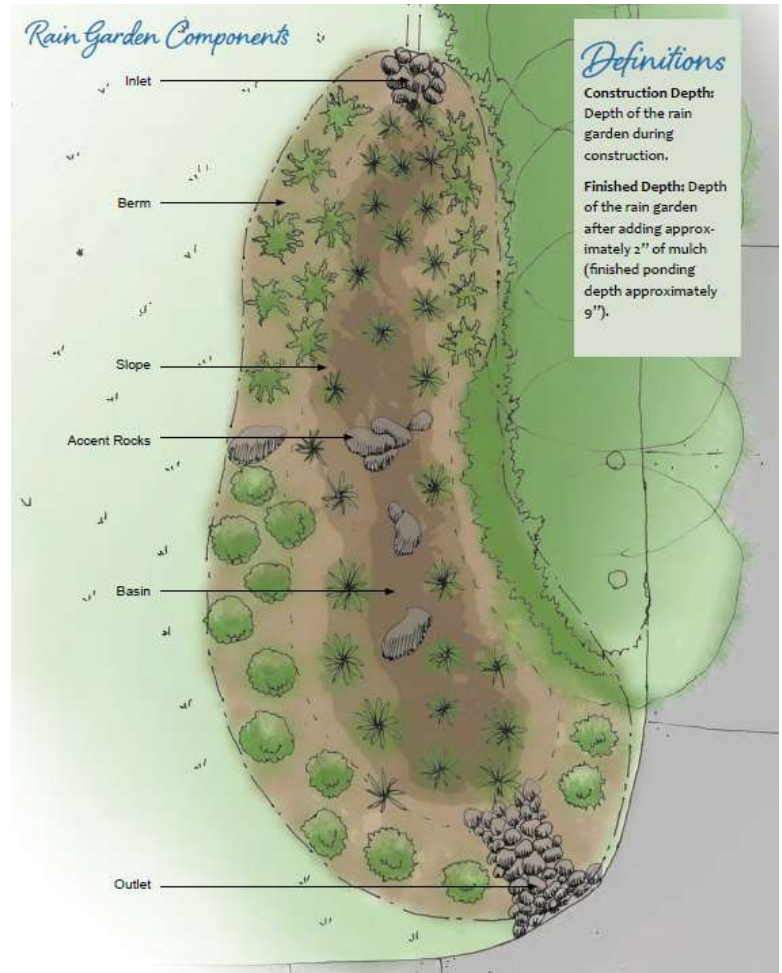


# Treatment Control BMPs - Retention



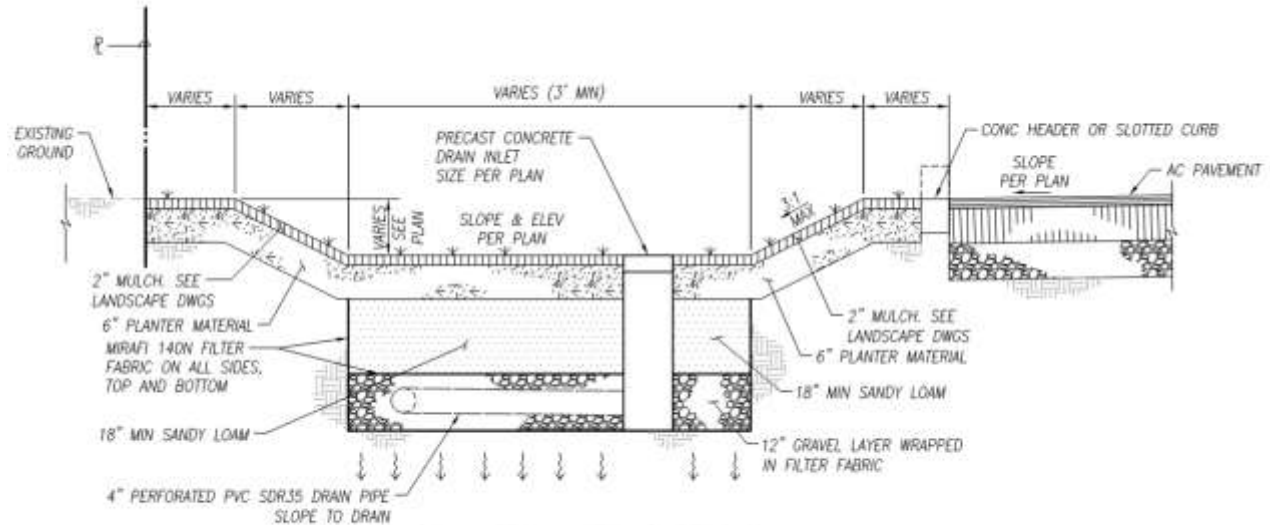


# Treatment Control BMPs - Retention

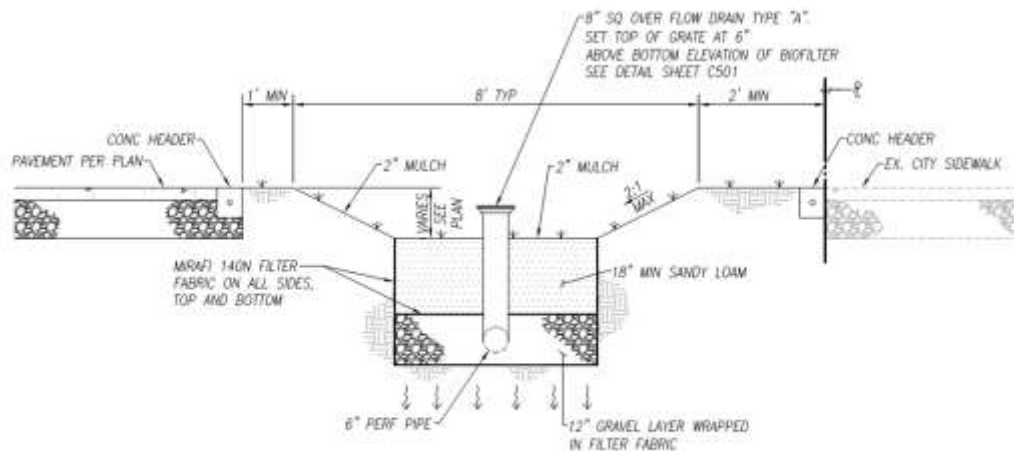


[www.huihawaii.org](http://www.huihawaii.org)

# Treatment Control BMPs - Retention



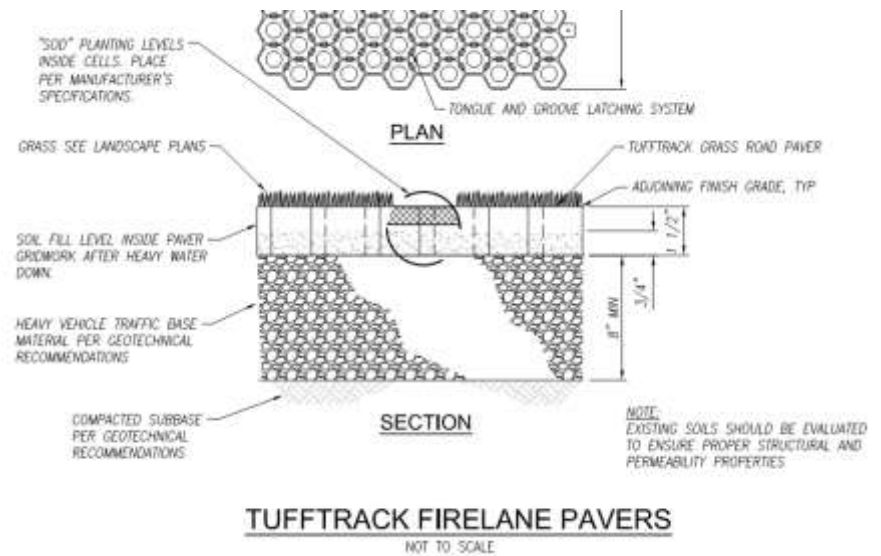
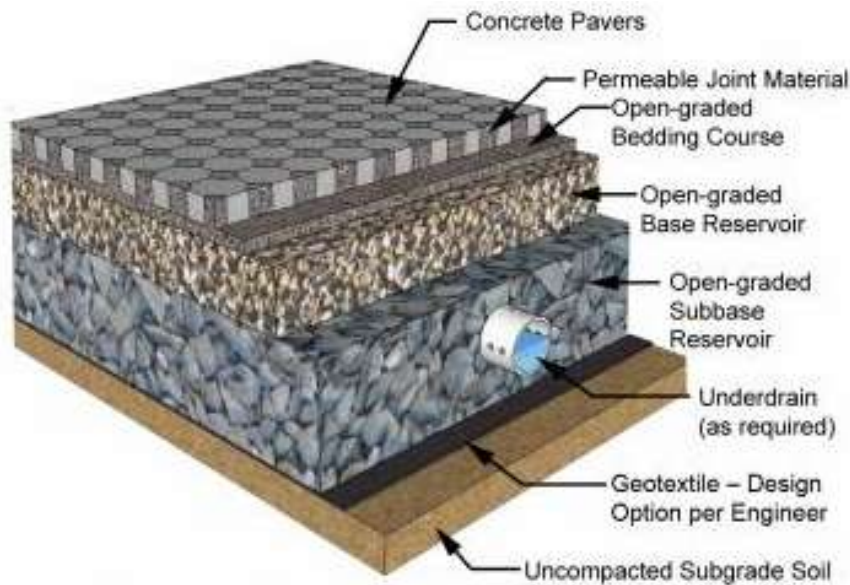
**ENHANCED SWALE (PRIVATE)**



**VEGETATED BIO-FILTER (PRIVATE)**

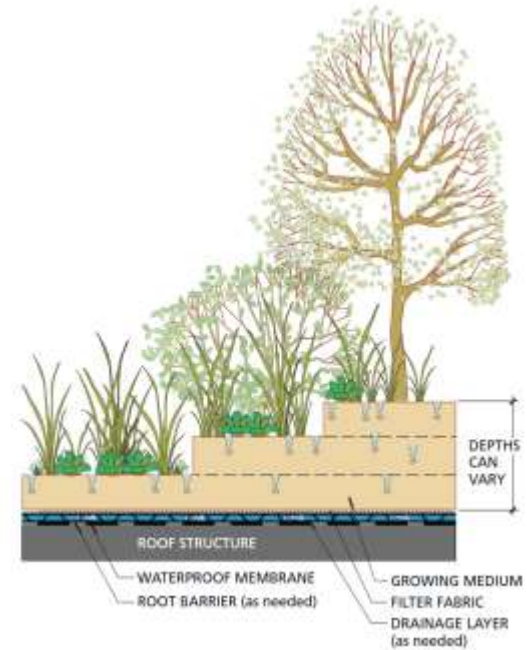
NOT TO SCALE

# Treatment Control BMPs - Biofiltration

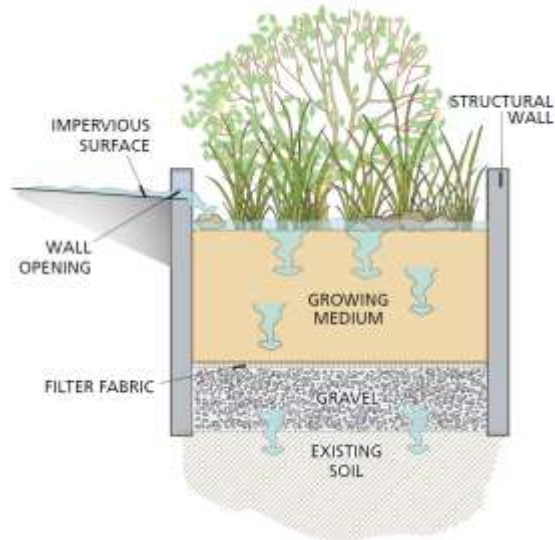
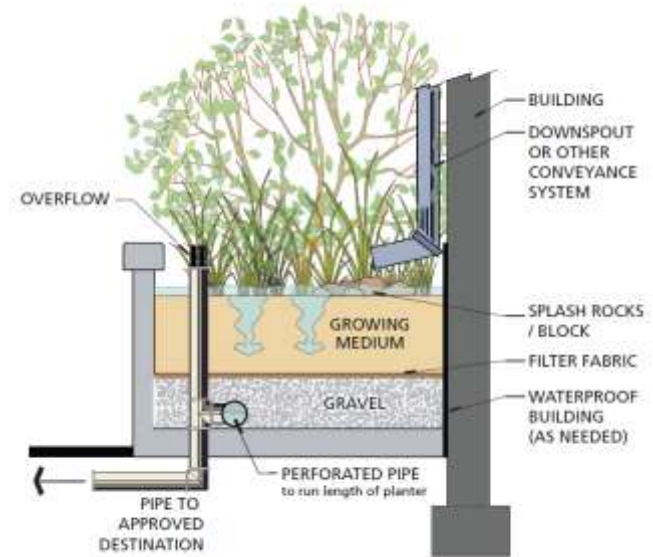




# Treatment Control BMPs - Biofiltration



# Treatment Control BMPs - Biofiltration

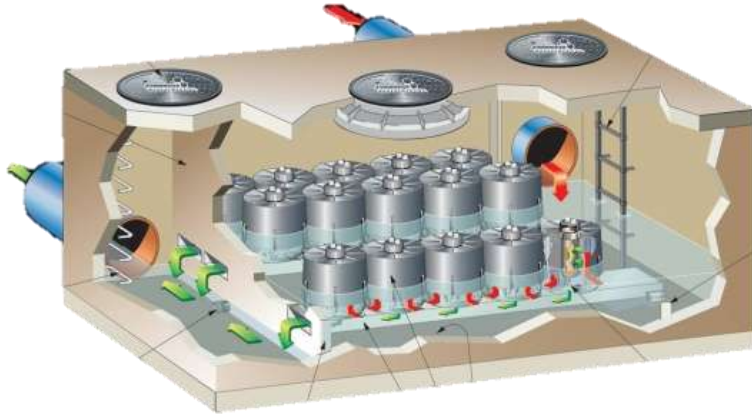




# Treatment Control BMPs - Biofiltration



# Alternative Compliance BMPs



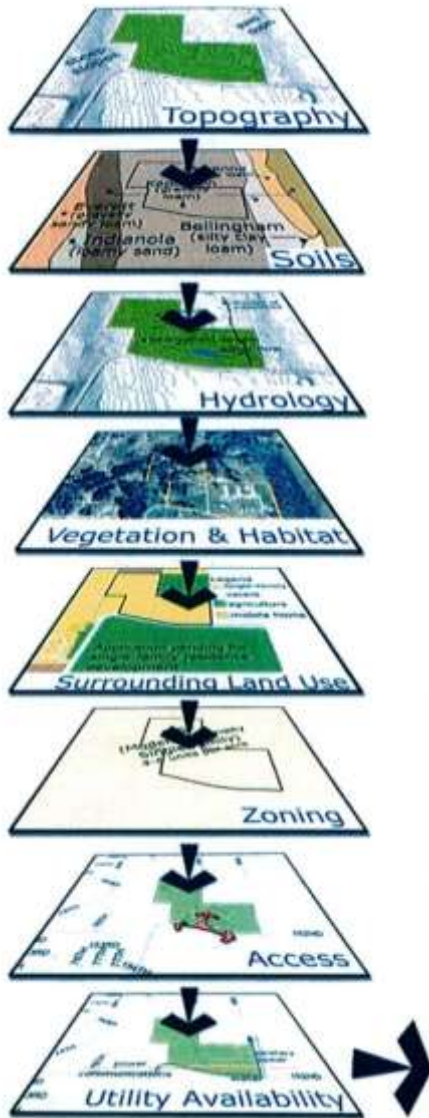


# Low Impact Development - Design Process

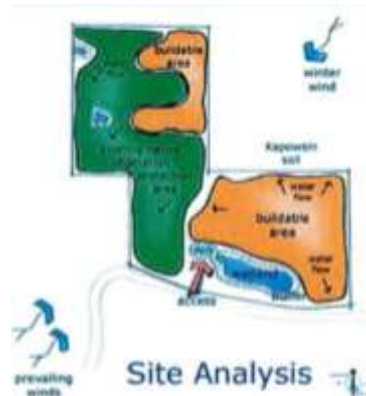
- **Discovery and Data Collection**
- **Conceptual Design/Master Planning**
- **Entitlements/Environmental Permitting**
- **Schematic Design**
- **Design Development**
- **Construction Documents**
- **Construction Observation**
- **Project Closeout**
- **Operation and Maintenance**

## Low Impact Development - Design Process

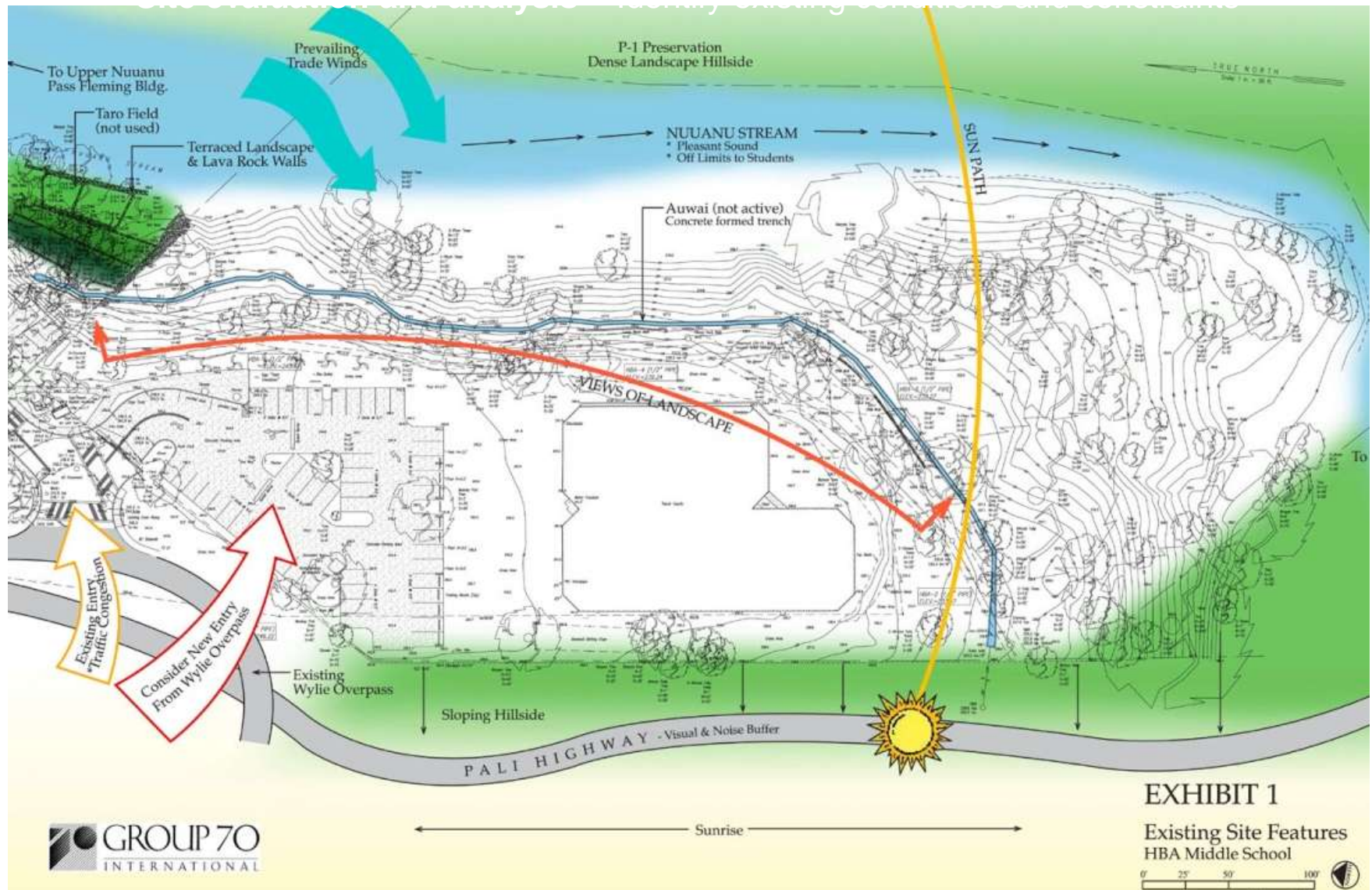
## Discovery and Data Collection



- **Site Analysis**
  - Topo – GIS, LiDAR, Survey
  - Soils – Percolation Rates, Groundwater
  - UHM Rainfall Atlas
  - UHM Evapotranspiration Rates
  - NOAA Atlas 14
  - Infrastructure
- **Design Criteria**
  - C&C Standards – Water Quality and Flood Control
  - Uniform Plumbing Code
  - FEMA, USACE, DLNR, SHPD
- **Deliverable/Outcome – Existing Conditions Assessment**



# Low Impact Development - Design Process





# Low Impact Development - Design Process

## Conceptual Design/Master Planning

- **Choose your team**
- **Define scope, objectives and goals**
- **Studies/Fieldwork**
  - Boundary/Topographic Survey
  - Geotechnical Investigation
  - Environmental Studies
- **Identify Programmatic Requirements**
  - Indoor and Outdoor Spaces
- **Design Charrette – Come Prepared!**
  - BMP ideas/menu
  - Hydrologic Data/Estimates
  - Quantity and Quality – Range of Events
  - ROM Cost and Sizing Metrics
- **Design Work Sessions**
- **DPP Consultation**
- **Deliverable/Outcomes**
  - LID Opportunities Plan
  - Strategic Stormwater Plan
  - Basis of Design
  - Drainage Master Plan





# Low Impact Development - Design Process

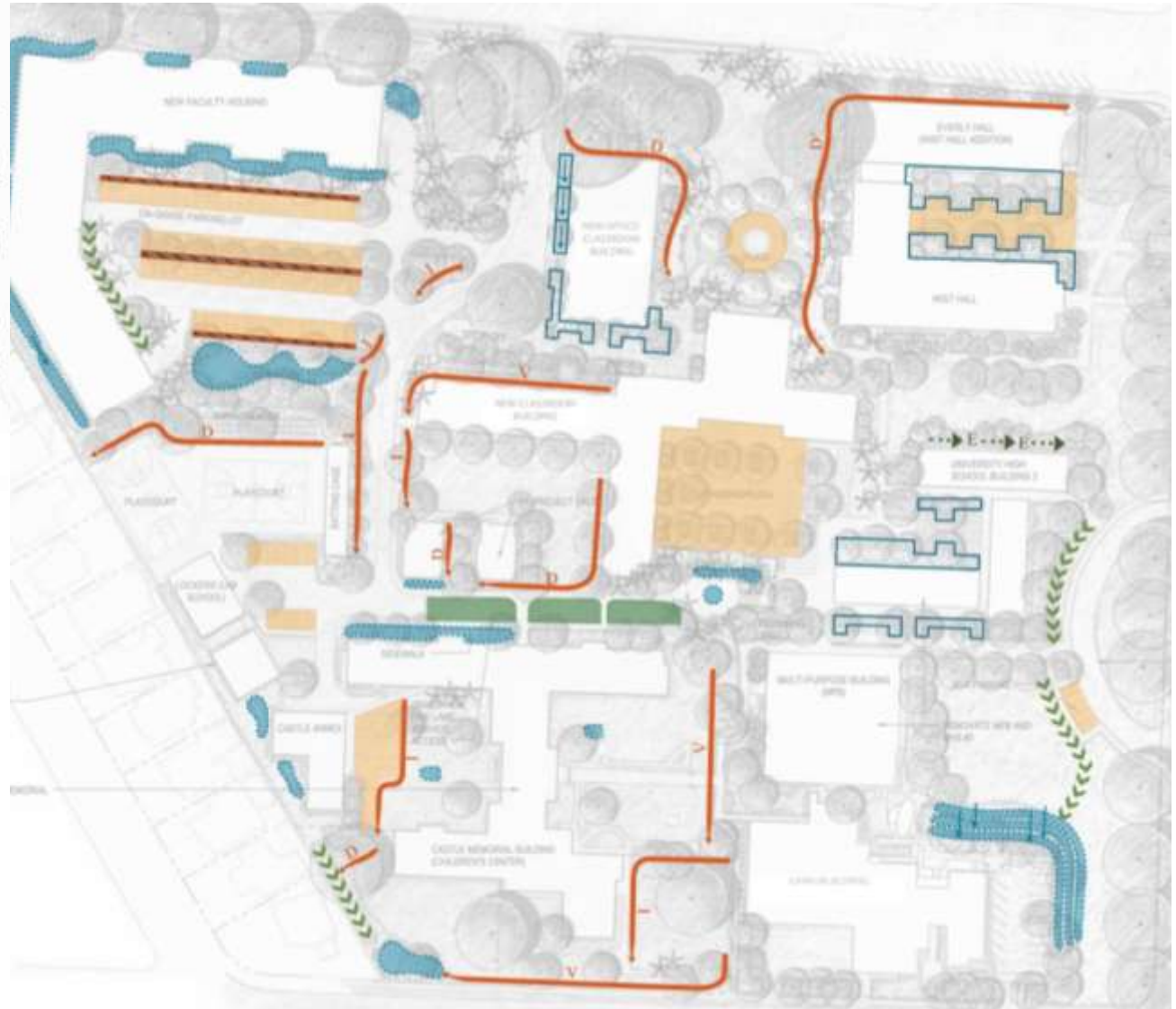
## Low Impact Development (LID) Opportunities

LID generally consists of 3 main components:

- Site Design Strategies that minimize runoff volume and preserve existing hydrology;
- Retention features (volume based) that retain water from small storm events and discharge overflows for larger storm events; and
- Bio-filtration features (flow-through based) that utilize natural processes to filter and treat and convey stormwater for all storm events;

The LID opportunities plan in Figure 15 indicates potential areas to incorporate LID features. However, selection of features to include in each project phase is dependent on site specific design and project limits of proposed phases.

-  Grass Paver
-  Permeable Pavement
-  Vegetated Swale
-  Enhanced Swale
-  Rain Garden
-  Tiered Rain Garden
-  Bio-filter (Planter Box)
-  Tiered Bio-filter (Planter Box)
-  Filter Strip
-  Dry Riverbed Trench
-  Vegetated Area Boundary Trench
-  Infiltration Trench



# Low Impact Development - Design Process



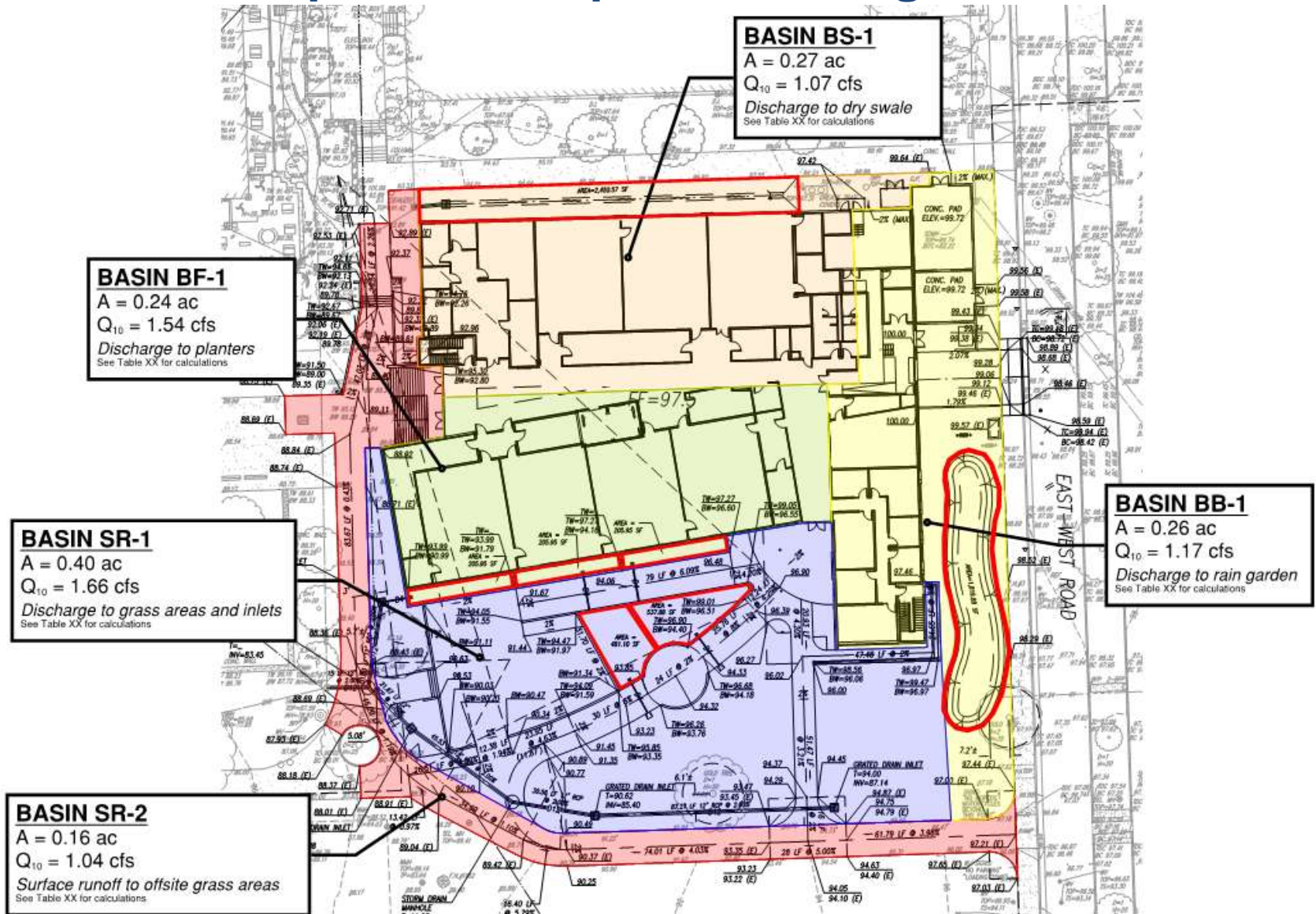
# Low Impact Development - Design Process

## Schematic Design

- **Revisit and Evaluate Concept Design**
- **Design Work Sessions**
- **Early and Continuous Design Coordination is Critical**
  - Roof Design and Downspout Locations
  - Review Floor Plans, Sections and Elevations – integrate BMPs on facades, plan for gutters and downspouts
  - Building and Site Structural – integrate BMPs, note which infiltrate and which are lined, elevation coordination
  - MEP Site Infrastructure – AC, PV, Vaults, Lines, Transformers
  - Tree Disposition Plan – if you are saving trees, consult arborist, review impacts and adjust design, avoid root zone impact
  - Planting and Irrigation Plans – must be integrated and designed concurrent with BMP design
- **Prepare Schematic Plans**
- **Prepare Basis of Design**
  - Establish Design Approach
  - Establish Feasibility
  - BMP sizing and hydrology/hydraulics
  - Refine/Update ROM Costs
- **DPP Consultation – Standards Compliance questions and Variances**
- **Deliverable/Outcomes**
  - Site and Utility Plan
  - Drainage and Grading Plan
  - Post Construction BMP plan OR Strategic Stormwater Plan
  - Basis of Design

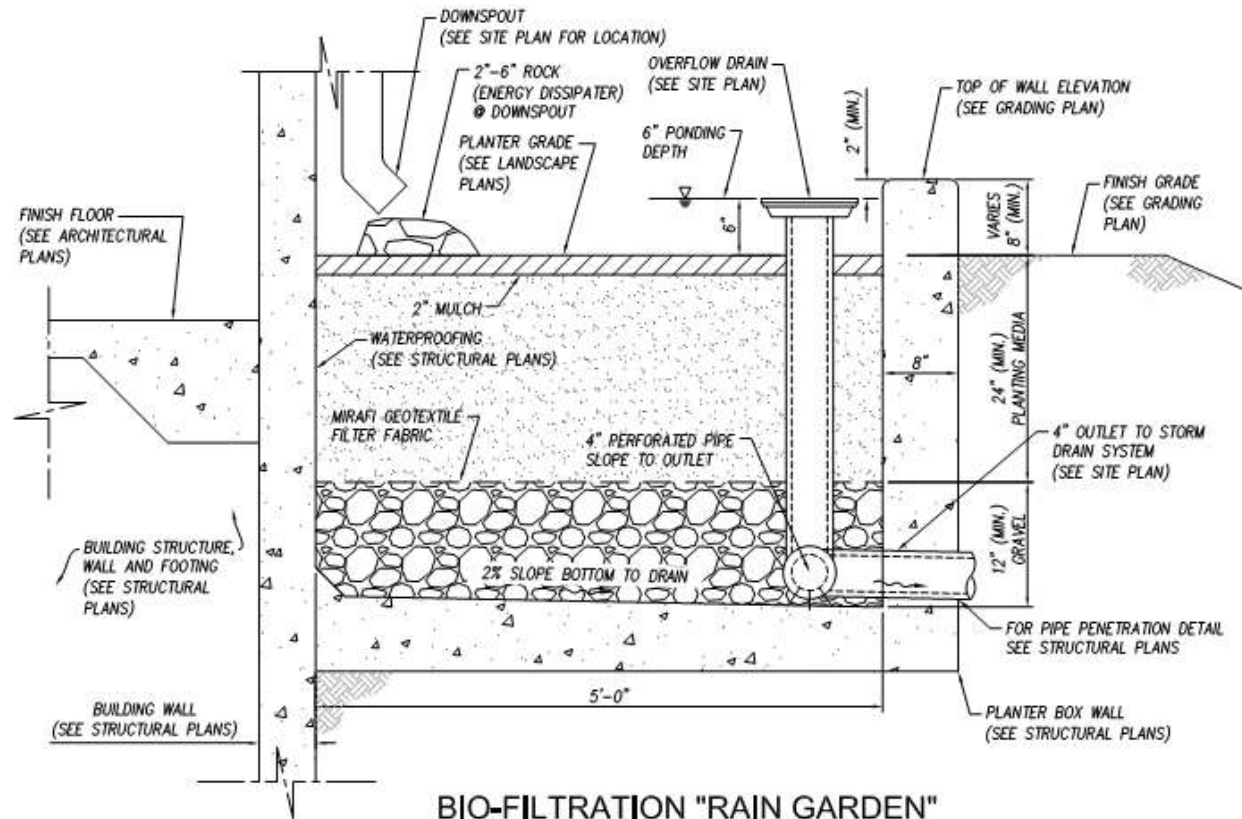


# Low Impact Development - Design Process



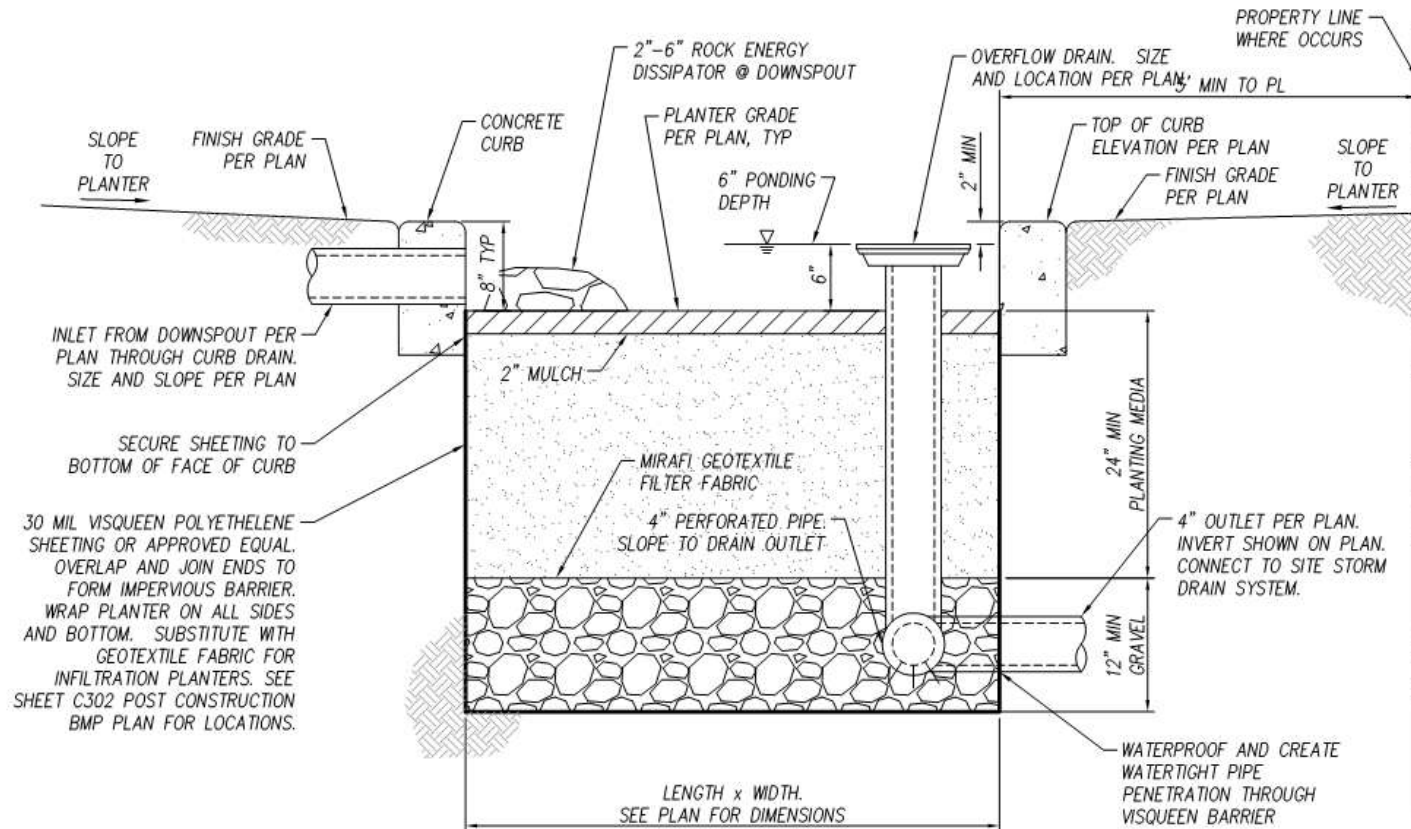


# Low Impact Development - Design Process



**BIO-FILTRATION "RAIN GARDEN"  
PLANTER BOX INTEGRATED WITH  
BUILDING WALL (PRIVATE)  
NOT TO SCALE**

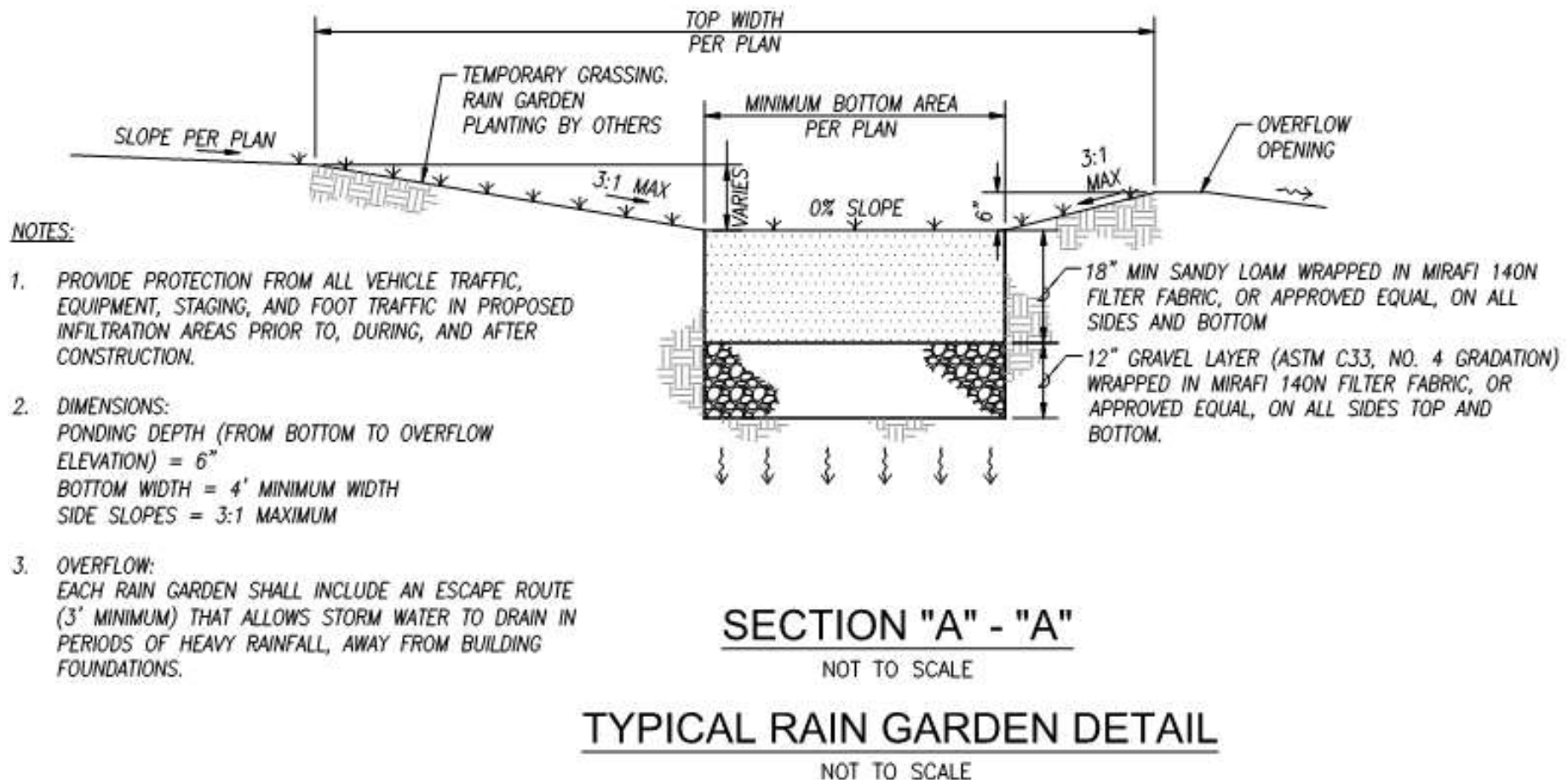
# Low Impact Development - Design Process



**BIO-FILTRATION "RAIN GARDEN"  
AT GRADE PLANTER (PRIVATE)**

NOT TO SCALE

# Low Impact Development - Design Process



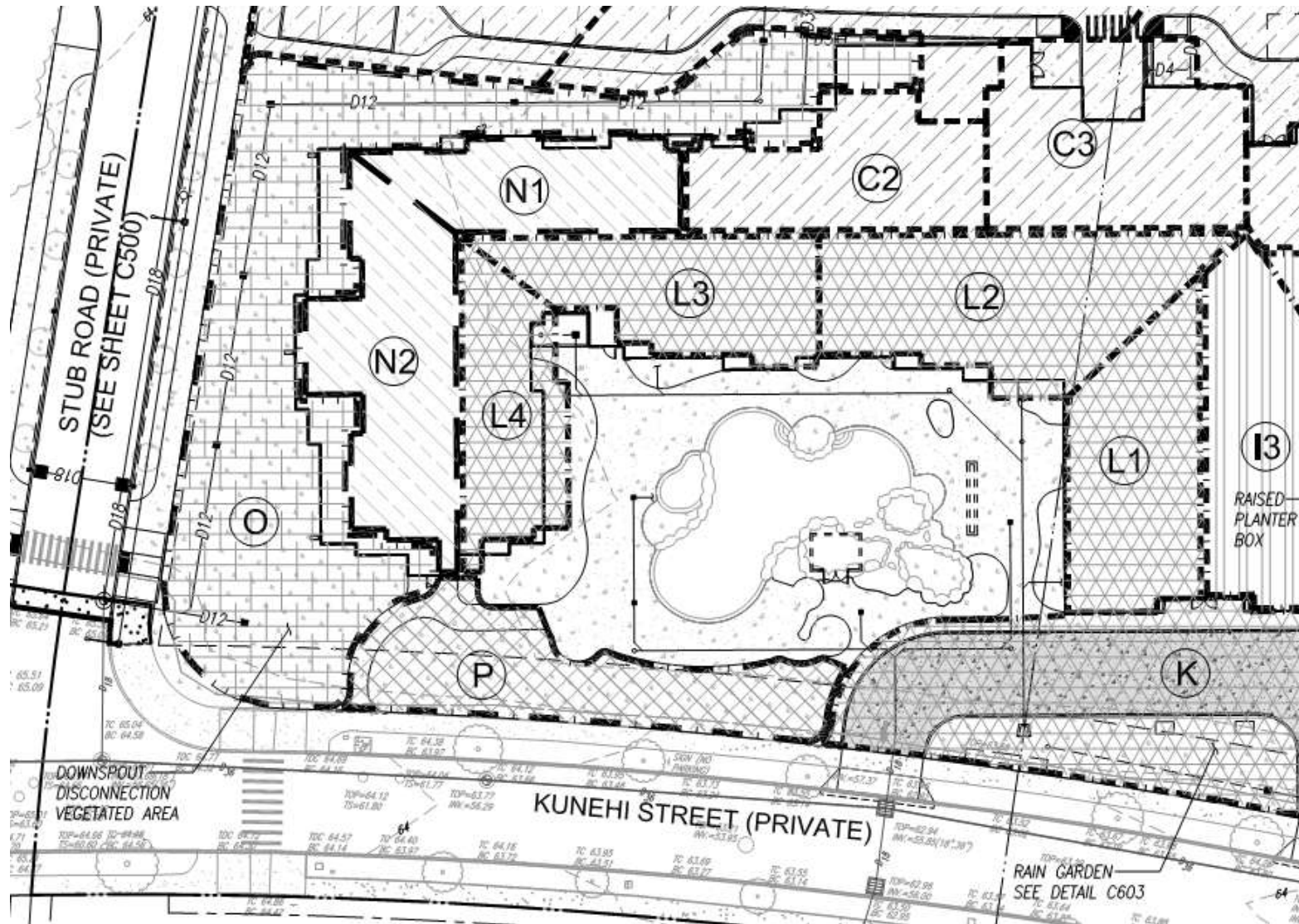
## Details - Plan







# Low Impact Development - Design Process



# Low Impact Development - Design Process

## POST CONSTRUCTION BEST MANAGEMENT PRACTICES (PRIORITY A2)

### 1. LID SITE DESIGN:

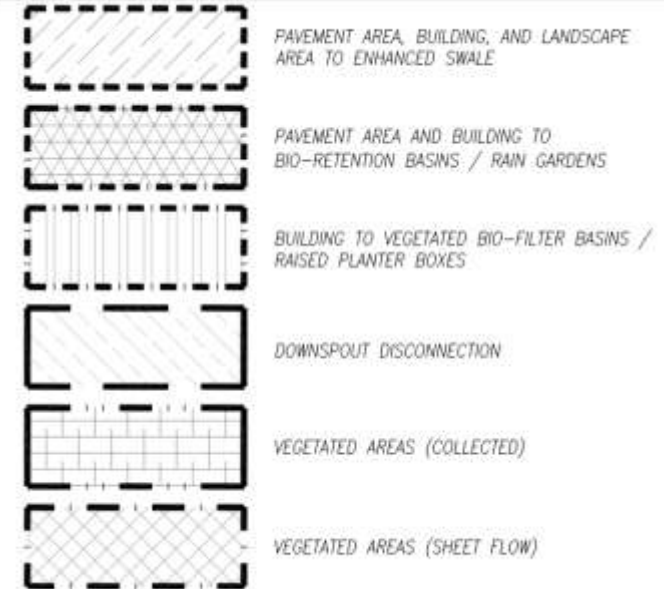
- A. ALL PERVIOUS AREAS WILL BE LANDSCAPED OR PAVED WITH PERMEABLE PAVEMENT.
- B. RUNOFF FROM IMPERVIOUS SURFACES ARE DIRECTED TO LANDSCAPED AREAS.

### 2. SOURCE CONTROL BMPs:

- A. LANDSCAPED AREAS WILL HAVE AUTOMATIC IRRIGATION SYSTEMS. SEE LANDSCAPE PLAN FOR DETAILS.
- B. OUTDOOR TRASH ENCLOSURES AND STORAGE AREAS WILL UTILIZE COVERED BINS AND WILL BE PAVED.
- C. LOADING DOCKS WILL DRAIN TO AND WILL BE TREATED BY THE INFILTRATION SYSTEM.
- D. PARKING AREAS WILL DRAIN TO AND WILL BE TREATED BY THE INFILTRATION SYSTEM.
- E. STORM DRAIN INLETS WILL HAVE STENCILS NOTING "DUMP NO WATER" AND "GOES TO OCEAN" STAMPED INTO THE CONCRETE ON THE TOP SLAB OF THE DRAIN INLET. SEE DETAIL SHEET C503.
- F. ALL PERVIOUS AREAS WILL BE LANDSCAPED. BIOFILTRATION SYSTEMS WILL BE UTILIZED AND SLOPES WILL BE MINIMIZED ON-SITE.

### 3. LID TREATMENT CONTROL BMPs:

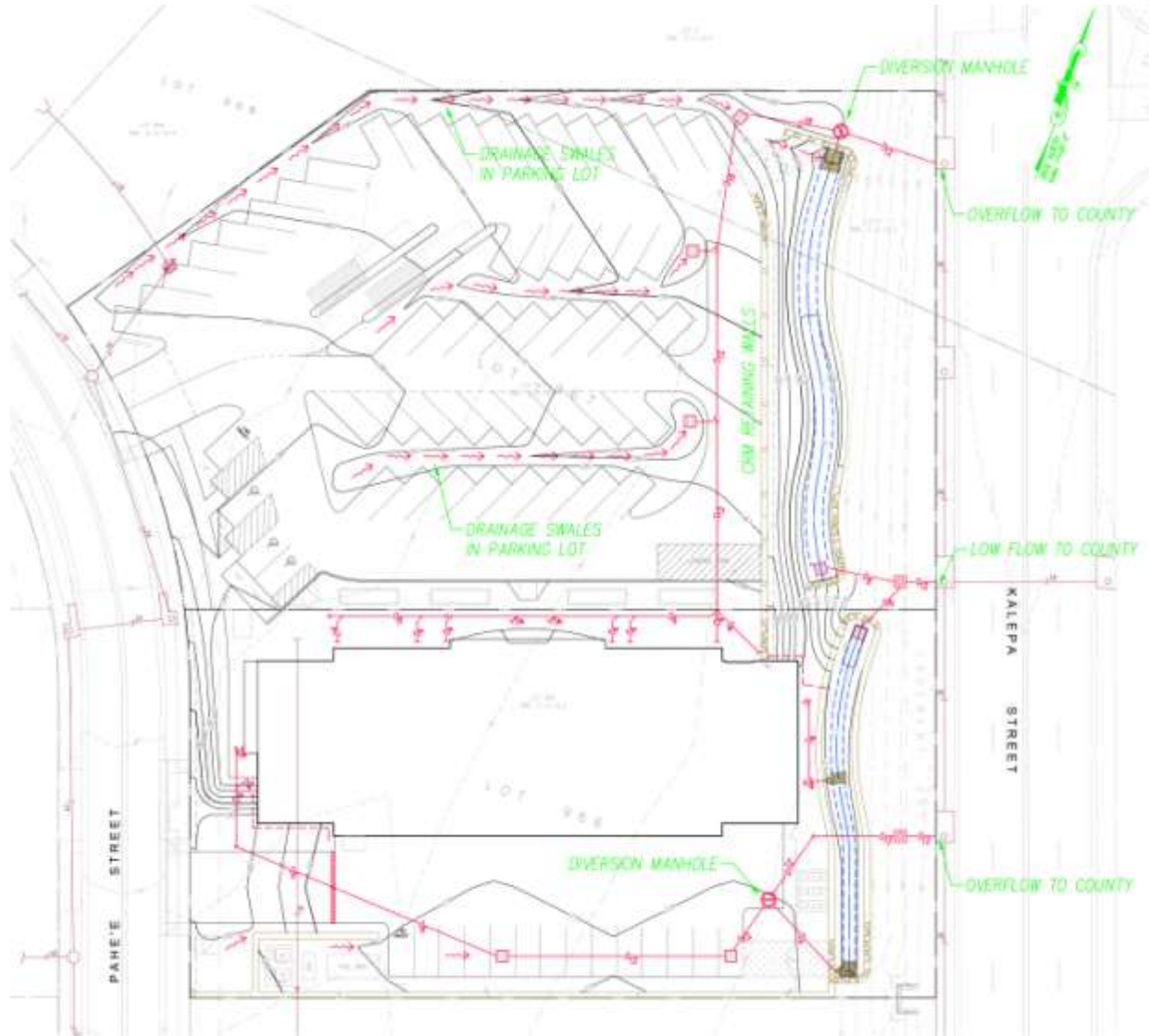
## LEGEND (POST CONSTRUCTION BMPs - PRIORITY A2)



## WATER QUALITY TABLE

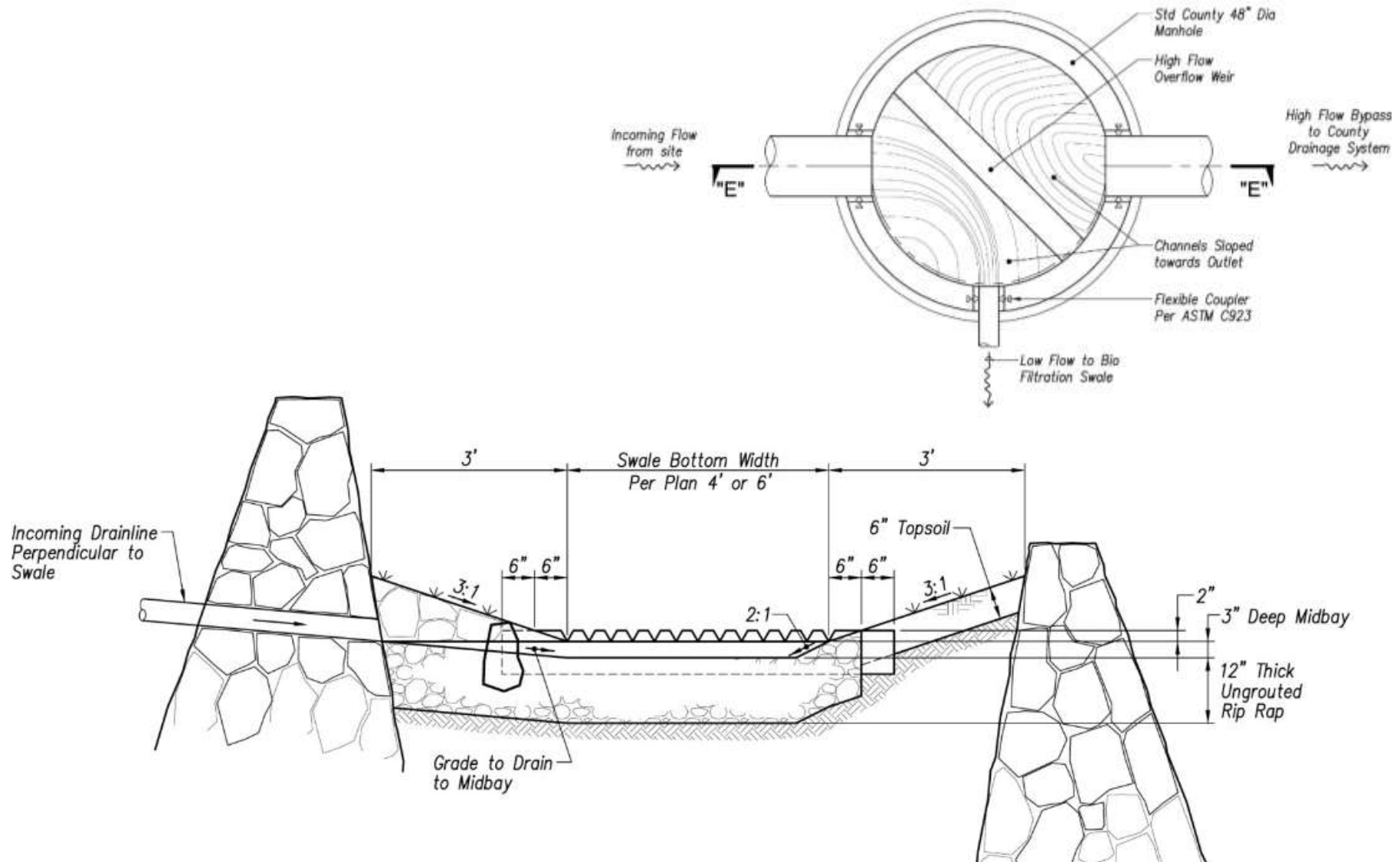
WQ BMP	BASIN	AREAS (ACRES)	$V_{WQV}$	BMP AREA REQUIRED (SF)	BMP AREA PROVIDED (SF)
BIO-RETENTION BASINS / RAIN GARDEN	H1, K, L	1.10	3327	2707	2804
ENHANCED SWALE	A, B, C, D, E, F	1.25	3242	6026	6380
VEGETATED BIO-FILTER / RAISED PLANTER BOXES	I	0.24	828	707	743
DOWNSPOUT DISCONNECTION	H2, H3, N1, N2	0.19	690	841	1350
VEGETATED AREAS (COLLECTED)	J, G, O	0.63	-		
VEGETATED AREAS (SHEET FLOW)	P, Q, R	0.29	-		

# Low Impact Development - Design Process





# Low Impact Development - Design Process





# Low Impact Development - Design Process



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# Low Impact Development - Design Process



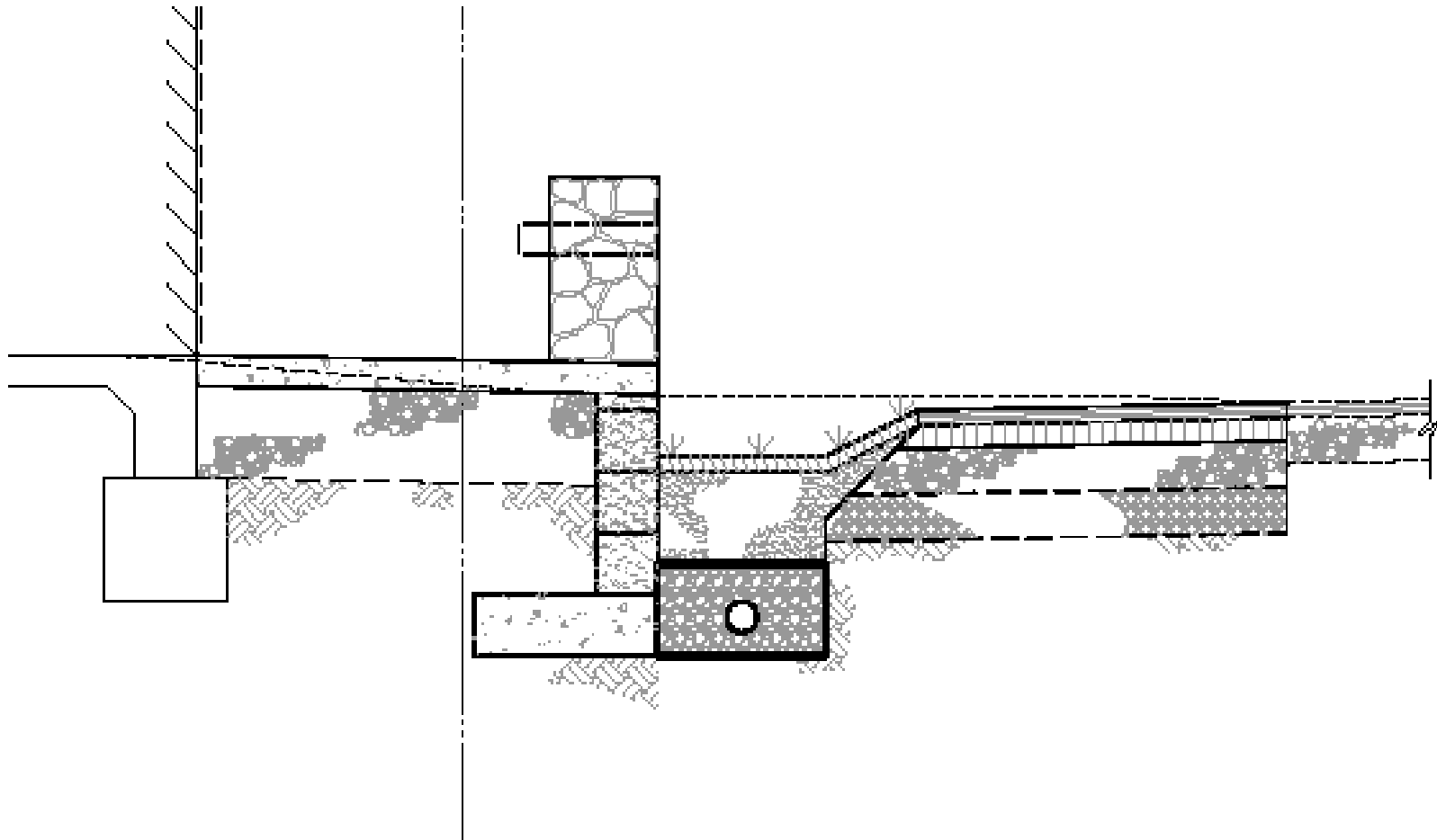


# Low Impact Development - Design Process



**Crosswalk Before**

# Low Impact Development - Design Process



Enhanced Swale



# Low Impact Development - Design Process



**Crosswalk After**

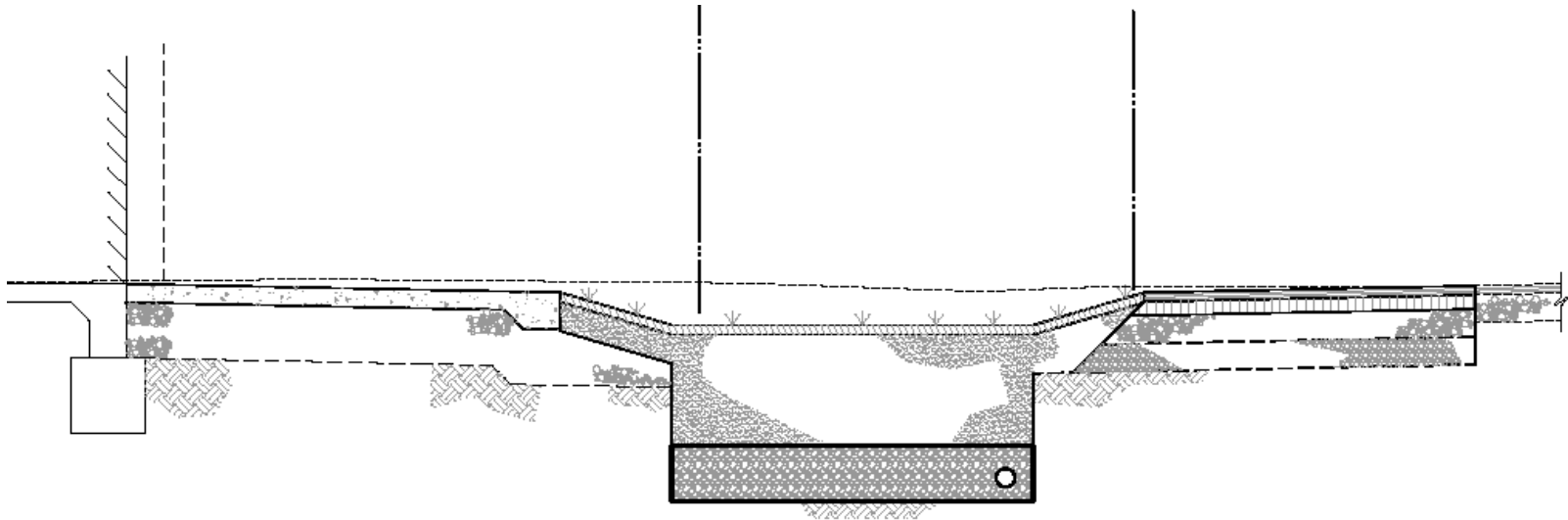


# Low Impact Development - Design Process



**Matsumoto Store Before**

# Low Impact Development - Design Process



**Enhanced Swale**



# Low Impact Development - Design Process



**Matsumoto Store After**





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MAHALO